230484 - NTECH - Nanotechnology

Coordinating unit: 230 - ETSETB - Barcelona School of Telecommunications Engineering
Teaching unit: 710 - EEL - Department of Electronic Engineering
713 - EQ - Department of Chemical Engineering

Academic year: 2017
Degree: BACHELOR’S DEGREE IN ENGINEERING PHYSICS (Syllabus 2011). (Teaching unit Optional)
ECTS credits: 6  Teaching languages: Catalan, Spanish, English

Teaching staff

Coordinator: - JOAQUIM PUIGDOLLERS GONZALEZ
Others: - RAMON ALCUBILLA GONZALEZ
- JORDI LLORCA PIQUÉ

Degree competences to which the subject contributes

Specific:

General:
3. ABILITY TO IDENTIFY, FORMULATE, AND SOLVE PHYSICAL ENGINEERING PROBLEMS. Planning and solving physical engineering problems with initiative, making decisions and with creativity. Developing methods of analysis and problem solving in a systematic and creative way.

Transversal:
1. THIRD LANGUAGE. Learning a third language, preferably English, to a degree of oral and written fluency that fits in with the future needs of the graduates of each course.
2. SELF-DIRECTED LEARNING - Level 3. Applying the knowledge gained in completing a task according to its relevance and importance. Deciding how to carry out a task, the amount of time to be devoted to it and the most suitable information sources.

Teaching methodology

Course is divided into two components: lectures and tutorials.

Lectures are provided by the course professors, who presents the essential course contents to the students. Not all course contents will be taught in the lecture sessions, so autonomous study is required. Tutorials will be conducted by external faculty members.

Learning objectives of the subject

Introduction to Principles, Fabrication Methods, and Applications of Nanotechnology
## Study load

<table>
<thead>
<tr>
<th>Total learning time: 150h</th>
<th>Hours large group:</th>
<th>65h</th>
<th>43.33%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self study:</td>
<td>85h</td>
<td></td>
<td>56.67%</td>
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</table>
## Content

### Introduction to Nanotechnology

<table>
<thead>
<tr>
<th align="left">Description:</th>
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<tbody>
<tr>
<td align="left">- What is it?</td>
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<tr>
<td align="left">- Size dependent properties.</td>
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<tr>
<td align="left">- Surface effects: Surface energies and surface tensions. Surface reactivity and catalysis.</td>
</tr>
<tr>
<td align="left">- Quantum effects: Tunneling, quantum confinement.</td>
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</tbody>
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**Learning time:** 4h 40m  
**Theory classes:** 1h 15m  
**Practical classes:** 0h 45m  
**Self study:** 2h 40m

### Nanomaterials

<table>
<thead>
<tr>
<th align="left">Description:</th>
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<tbody>
<tr>
<td align="left">- Nanoparticles.</td>
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<tr>
<td align="left">- Colloids.</td>
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<tr>
<td align="left">- Porous materials.</td>
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</tbody>
</table>

**Learning time:** 11h 40m  
**Theory classes:** 3h 05m  
**Practical classes:** 1h 55m  
**Self study:** 6h 40m

### Characterization Techniques

<table>
<thead>
<tr>
<th align="left">Description:</th>
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<tbody>
<tr>
<td align="left">- Optical Microscopy, IR, Raman, UV-VIS, Fluorescence, Confocal, DRX, Ellipsometry, XPS, Synchrotron.</td>
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<tr>
<td align="left">- SEM, TEM, EDX.</td>
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<tr>
<td align="left">- Tunnel effect techniques, AFM and related techniques.</td>
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**Learning time:** 11h 40m  
**Theory classes:** 3h 05m  
**Practical classes:** 1h 55m  
**Self study:** 6h 40m
# Reactivity of surfaces

**Learning time:** 23h 20m  
Theory classes: 6h 10m  
Practical classes: 3h 50m  
Self study: 13h 20m  

**Description:**  
- Gas-solid reactions.  
- Adsorption, Coverage, Calorimetry.  
- Infrared Spectroscopy with probe molecules and HREELS.  
- Sensors and catalysis.  
- Surface reconstruction.

## Fabrication and preparation

**Learning time:** 17h 30m  
Theory classes: 4h 35m  
Practical classes: 2h 55m  
Self study: 10h  

**Description:**  
- Top-down and bottom-up.  
- Lithographies: Optical (UV, DUV), e-beam litho, AFM based litho, Nanoimprint.  
- Growth of films.

## Molecular devices

**Learning time:** 29h 10m  
Theory classes: 7h 40m  
Practical classes: 4h 50m  
Self study: 16h 40m  

**Description:**  
- Organic LED.  
- Organic PV.  
- Organic FET.
**Nanoelectronics**

<table>
<thead>
<tr>
<th>Learning time: 49h 40m</th>
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<tbody>
<tr>
<td>Theory classes: 12h 15m</td>
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<tr>
<td>Practical classes: 7h 45m</td>
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<tr>
<td>Guided activities: 3h</td>
</tr>
<tr>
<td>Self study: 26h 40m</td>
</tr>
</tbody>
</table>

**Description:**
- Confinement; Density of states.
- MOS revisited and scaling down
- UTB and FINFET
- Quantum conductance
- Resonant Tunneling and devices.
- High performance lasers

**Qualification system**

Written exam
Work-term reports on specific topics

Partial exam (EP) (35%) + Final Exam (EF) (35%) + Presentation of the report (PT) (30%)
In case you need to recover the partial exam, the grade will be Max (+0.35 0.35EF EP; 0.7EF) +0.3 Report (PT)

**Bibliography**

**Basic:**
